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⑰ Applicant: TOKYO SHIBAURA DENKI KABUSHIKI KAISHA, 72, Horikawa-cho, Saitama-ku, Kawasaki-shi Kanagawa-ken 210 (JP)

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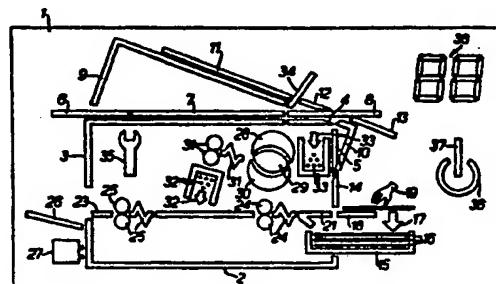
⑳ Inventor: Matsumoto, Hiroshi c/o, Tokyo Shibaura Denki K.K., Patent Division 72, Horikawa-cho, Saitama-ku, Kawasaki-shi Kanagawa-ken (JP)  
Inventor: Ishikawa, Yuji c/o, Tokyo Shibaura Denki K.K., Patent Division 72, Horikawa-cho, Saitama-ku, Kawasaki-shi Kanagawa-ken (JP)  
Inventor: Nakamine, Chosin c/o, Tokyo Shibaura Denki K.K., Patent Division 72, Horikawa-cho, Saitama-ku, Kawasaki-shi Kanagawa-ken (JP)

㉑ Designated Contracting States: DE FR GB NL

㉒ Representative: Kirk, Geoffrey Thomas et al., BATCHELLOR, KIRK & EYLES 2 Pear Tree Court, Farringdon Road, London EC1R 0DS (GB)

### ㉓ Display device for a machine.

㉔ A display device according to the present invention is incorporated into a machine in order to display the operating condition of the machine. The machine has at least one movable part, such as a door, to be opened by an operator when the machine stops operating due to a malfunction. This display device schematically shows, by means of display elements, the positions of the movable parts before and after the operator moves them, and displays the elements in accordance with the condition of the machine. Upon the occurrence of a malfunction in the machine, the display elements on the schematic display corresponding to the faulty machine part can be displayed so as to be understood by the operator.



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DISPLAY DEVICE FOR A MACHINE

5        This invention relates to a display device for displaying operating conditions of a machine. A particular, but not sole, application of the invention is to a display device for displaying operating conditions of an electrophotographic copying machine.

10      These machines which transport a medium, such as paper, are required to transport the paper at high speed to increase the throughput of the machine. However, the higher the transporting speed, the greater is the incidence of jamming of the paper in the transportation path. When jamming occurs, the machine 15      stops further transportation behind the jammed paper and, at the same time, stops all the operating functions of the machine. It is then necessary for an operator to take out the jammed paper, thereby removing the cause of the fault, so that the machine can quickly 20      be returned to operation.

25      To meet this demand, as shown in U. S. Patent Specification No.4,176,941, it has been made possible for the operator to detect the location of the fault by means of a device displaying a schematic representation of the electrophotographic machine and also displaying on the display the location of the jam (in case of paper jamming) or other fault.

However, though this display enables the operator to detect the location of the fault, it is difficult for an unskilled operator to understand how to remedy the fault. Unless a skilled operator is present to correct the fault, the machine remains out of use for some time until a skilled operator can be fetched to correct the fault.

5 An object of the present invention is to provide a display device suitable for a machine, the 10 device enabling even unskilled operators to properly 15 carry out repair work in case of a malfunction on the machine.

According to the present invention, for use 15 with a machine having a plurality of component parts, at least one of which is movable to permit access to 20 be made to other component parts of the machine, a display device comprises a plurality of display segments formed to schematically illustrate at least some of said component parts, including said movable part, and display control means coupled to said display 25 segments for activating selected ones of said display segments in response to the occurrence of a malfunction characterised in that said display control means activates said display segment(s) corresponding to the or each movable part which must be moved to enable the malfunction to be corrected.

In this display device, where the malfunction

of the machine requires an operator to move one or more of the movable parts, the display elements are activated to show schematically the positions in which the movable parts should be after they have been moved. 5 Therefore, where the operator of the machine is unskilled, and not trained in the repair procedure, the operator, by looking at this display device, can instantly understand which movable part of the machine to move and in which direction to move it upon the occurrence of a malfunction. The invention is 10 especially useful when the machine, such as an electrophotographic copying machine, is to be operated not only by a skilled operator but also by unskilled personnel.

15 In order that the invention may be more readily understood, it will now be described, by way of example only, with reference to the accompanying drawings, in which:-

20 Figure 1 is an elevational view of a copying machine utilising a display device according to the present invention;

Figure 2 shows the display device of this invention;

25 Figure 3 is a block diagram of a display control circuit to activate the display device shown in Figure 2;

Figures 4 and 5 are signal waveform diagrams

for the block diagram of Figure 3; and

Figures 6 to 17 show examples of various displays on the display device of Figure 2.

Figure 1 shows an electrophotographic copying machine C. As shown at the upper left, a display device 1 is positioned on the surface of the casing 50. In this copying machine C, an original-carrier 51, mounted with an original (not shown) is designed to freely reciprocate in the X directions by a drive mechanism (not shown). The original is then illuminated by an illumination system (not shown) and the reflected light forms an electrostatic latent image of the original on the surface of a photosensitive member (not shown). In the meantime, a single sheet of paper is removed from a cassette 52, or guided on a manual feed tray 53, and is transported to the photosensitive member. The electrostatic latent image on the photosensitive member is developed by the toner in a developer unit (not shown). The developed image is then transferred on to the paper by a transfer mechanism (not shown). The paper is then guided to a fusing mechanism (not shown) and thereafter discharged on to a tray 54. The casing 50 is constructed of two covers, an upper cover 56 and a lower cover 57. The upper cover 56 can be raised or lowered in the directions of arrow Y, pivoting about a hinge pin 58. The upper cover 56 and lower cover 57 are separated

along line 55 and paper can easily be removed if it becomes jammed along the transportation path in casing 50. A part 59, indicated with a dotted line, is a top cover for covering a toner hopper (not shown) in casing 50. If the original-carrier 51 is moved to the left, the operator can swing top cover 59 in the direction of arrow Z and can replenish the toner in the toner hopper through the gap between the upper cover 56 and top cover 59.

is a segment for displaying the copying paper in paper feed cassette 51; 17 is an arrow indicating the absence of copying paper; 18 is a segment for displaying manual paper feed tray 53; and 19 is a 5 segment indicating that the copying machine is in the manual paper feeding mode.

Furthermore, 21, 22 and 23 are segments for displaying the transport passage through which the copying paper passes; 24 is a segment for indicating the occurrence of paper jamming in the transport 10 passage; 25 is a segment for indicating the occurrence of paper jamming in the fuser or paper discharge section; 26 is a segment for displaying discharge tray 54, 27 is a segment indicating to the operator that he should connect a key counter to count the number of copies; 28, 29 and 30 are segments for indicating the photosensitive drum on which the electrostatic latent image is formed; 31 is a segment 15 for indicating paper separation from the photosensitive drum; 32 is a segment for indicating that the recovered-toner storage bin is filled up with the recovered toner; 33 is a segment for indicating that the toner hopper of the developing unit is empty; and 34 is a segment for displaying the top cover 59, 20 indicating to the operator to supply toner by opening the cover 59. Still further, 35 is a segment for 25 indicating the necessity of a periodical check on, for

example, the replacement of consumables (filter, photosensitive drum and heat-roller); 36 and 37 are segments for indicating the machine's ability to copy (the "ready" condition). Segment 36 alone indicates that the copying machine C is able to copy, and both segments 36 and 37 indicate that copying machine C is unable to copy. 38 is a pair of seven-segmental numeral displays for indicating the number of copies. On the face of the aforementioned segments, a common electrode is provided, although not shown in the figure.

Figure 3 is a display control circuit for activating the display segments shown in Figure 2. Main control 41 is a microcomputer which controls copying machine C and outputs the condition of the machine in four binary digits through terminals  $0_1$ ,  $0_2$ ,  $0_4$  and  $0_8$ . Main control 41 is connected to a decoder circuit 42, and the binary signal from main control 41 is input to input terminals  $I_1$ ,  $I_2$ ,  $I_4$  and  $I_8$ . The signal is decoded as shown in Table 1. The decoded signal (i.e. segment signal) is outputted through output terminals  $S_1$  to  $S_{18}$ . Table 1 is a truth table explaining the states of output terminals  $S_1$  to  $S_{18}$  which correspond to the various inputs at input terminals  $I_1$ ,  $I_2$ ,  $I_3$  and  $I_4$ .

Table 1

The decoded output signal from each output terminal ( $S_1$  to  $S_{18}$ ) of decoder circuit 42 is supplied respectively to an input terminal of exclusive OR circuits  $43_1$  to  $43_{18}$  (hereinafter referred to as EOR circuits). To the other input terminal of EOR circuits  $43_1$  to  $43_{18}$  is supplied the output signal from an oscillator 44, via an inverter 45. Oscillator 44 supplies the AC signal for driving the liquid crystal display elements. Each output of EOR circuits  $43_1$  to  $43_{18}$  is supplied to corresponding circuit segments  $46_1$  to  $46_{18}$  of the liquid crystal display, and the output of inverter circuit 45 is supplied to the common electrode 47. Each of circuit segments  $46_1$  to  $46_{18}$  activates one or more of display segments 2-37 as shown in Table 2 below.

TABLE 2

Circuit segment in Fig. 3	Display segment of display device 1 in Fig. 2
$46_1$	2, 14, 18, 26, 29, 36
$46_2$	2, 5, 7, 30
$46_3$	4, 8
$46_4$	9, 10, 11, 12, 13, 26
$46_5$	21, 24
$46_6$	22, 23, 25
$46_7$	6
$46_8$	15
$46_9$	16
$46_{10}$	17
$46_{11}$	19
$46_{12}$	27
$46_{13}$	31
$46_{14}$	32
$46_{15}$	33
$46_{16}$	34
$46_{17}$	35
$46_{18}$	37

Therefore, only circuit segments  $46_1$  to  $46_6$ , among the circuit segments in Fig. 3, are connected with a plurality of display segments in Fig. 2 as shown clearly in the above Table 2.

There follows a discussion of the operation of the display device, referring to the timing charts in Fig. 4 and Fig. 5. Fig. 4 shows the process by which copying machine C indicates that it is able to copy after the power switch of copying machine C has been turned on. Fig. 5 shows the result of copying paper running out during a copying operation. In Fig. 4, when the power switch is turned on at time  $t_0$ , main control 41 starts operation according to the program previously programmed and outputs a command for supplying power to the fusing heater. Simultaneously, the main control 41 outputs the code signal "1" (binary 0001) showing the standby condition (unable to copy) of copying machine C from output terminals  $0_1$ ,  $0_2$ ,  $0_4$  and  $0_8$ , since at this time, the fusing heater has not yet reached operating temperature. This code signal (0001) enters input terminals  $I_1$ ,  $I_2$ ,  $I_4$  and  $I_8$  of decoder circuit 42. The output terminals  $S_1$  to  $S_{18}$  of decoder circuit 42 become (111000011000000001) as shown in Table 1. In Fig. 4, the waveforms corresponding to output terminals  $S_1$ ,  $S_4$  and  $S_8$  of decoder circuit 42 are shown, but those corresponding to the other output terminals  $S_2$ ,  $S_3$ ,  $S_5$ ,  $S_{17}$  also can be obtained as shown in Table 1. When the output terminal  $S_1$  of decoder circuit 42 is indicating "1," the output signal of EOR circuit  $43_1$  is  $180^\circ$  out of phase with the output signal of inverter circuit 45 as shown in Fig. 4(f), and is applied to circuit segment  $46_1$ . At this time, the output signal of inverter circuit 45 is also applied to common electrode 47, and an AC voltage as shown in Fig. 4(g) exists between circuit segment 46, and common electrode 47. As a result, segment  $46_1$ , as shown in Table 2, activates display segments 2, 14, 18, 26, 29 and 36 in Fig. 2. Similarly, when output terminals  $S_2$ ,  $S_3$ ,  $S_8$ ,  $S_9$  and  $S_{18}$  of decoder circuit 42 indicate "1," an AC signal as shown in Fig. 4(g) exists between the segments corresponding to these output terminals and common electrode 47 and each of these display segments is activated. When the output terminal  $S_4$  of decoder circuit 42 is in phase with the output signal of inverter circuit 45, as shown in Fig. 4(i), and is applied to circuit segment  $46_4$ , since the output signal of

inverter circuit 45 is also applied to common electrode 47, no potential difference is produced between circuit segment  $46_4$  and common electrode 47 as shown in Fig. 4(j). As a result, the display segments 9, 10, 11, 12, 13 and 28 corresponding to circuit segment  $46_4$  in Table 2 are not activated. Similarly, since output terminals  $0_1$ ,  $0_2$ ,  $0_4$  and  $0_8$  of the main control indicate (0001), the output terminals  $S_5$ ,  $S_6$ ,  $S_7$ ,  $S_{10}$ ,  $S_{11}$ ,  $S_{12}$ ,  $S_{13}$ ,  $S_{14}$ ,  $S_{15}$ ,  $S_{16}$  and  $S_{17}$  of decoder circuit 42 are also zero volt signals as shown in Fig. 4(h), and the display segments corresponding to these output terminals are not activated. Accordingly, the display schematic at this time appears as shown in Fig. 6 and indicates that copying machine C is in a standby condition (unable to copy). At this time, main control 41 displays the number of copies, "0," on the numeral display 38.

When the operating temperature of the fusing heater is attained and copying machine C becomes able to copy at time  $t_1$  in Fig. 4, main control 41 outputs a code signal "2" (binary 0010) from output terminals  $0_1$ ,  $0_2$ ,  $0_4$  and  $0_8$ . When this is decoded, output terminals  $S_1$  to  $S_{18}$  of decoder circuit 42 become (11100001100000000000), the only difference from the standby condition being that terminal  $S_{18}$  is at level "0" rather than level 1. As a result, the voltage applied to circuit segment  $46_{18}$  is in phase with the output of inverter 45, display segment 37 in Fig. 2 does not light, and a ready condition (able to copy) is displayed as shown in Fig. 7. At this time, main control 41 displays the number "1" on numeral display 38.

As shown in Fig. 5, during a copying operation, main control 41 outputs a specific code signal, for example, signal "0" (binary 0000), indicating that the machine is in the process of copying. Accordingly, all output signal  $S_1$  to  $S_{18}$  of decoder circuit 42 become "0" as shown in Table 1. As a result, a zero volt signal is applied between each of segments  $46_1$  through  $46_{18}$  and common electrode 47, and all display segments 2 through 37, are deactivated. In this case, as shown in Fig. 8, the display is blank except for a numeral in part 38. This shows that the copying machine is copying.

At time  $t_2$  during copying, when the absence of copying paper in paper feed cassette 52 is detected by a detector (not shown), main

control 41 stops the operation of copying machine C according to the program and simultaneously outputs a code signal showing "absence of copying paper," signal "3" (binary 0011). When this signal is decoded, the output terminals  $S_1$  to  $S_{18}$  of the decoder circuit become (111000010100000001) as shown in Table 1. As a result, an AC signal is applied only between circuit segments  $46_1$ ,  $46_3$ ,  $46_8$ ,  $46_{10}$ ,  $46_{18}$  and common electrode 47 and thus display segments 2, 3, 4, 5, 7, 8, 14, 15, 17, 18, 26, 29, 30, 36 and 37 corresponding to these circuit segments are activated and other segments are not. Accordingly, the display in this case is as shown in Fig. 9 and indicates the absence of copying paper in copying machine C. In Fig. 9, the number "41" in the numeral display shows that copying paper ran out after 41 sheets had been copied. In this case, display segment 17, indicating the absence of copying paper, can be made more conspicuous by flickering instead of lighting continuously.

Although for this condition the timing chart is not illustrated, when jamming of copying paper occurs in the paper supply path and is detected by a detector (not shown), main control 41 stops the operation of the copying machine and simultaneously outputs a code signal showing "paper jamming the supply path," signal "9" (binary 1001). When this is decoded, the output terminals  $S_1$  to  $S_{18}$  of decoder circuit 42 become (100110011000000001) as shown in Table 1. As a result, an AC signal is applied between circuit segments  $46_1$ ,  $46_4$ ,  $46_5$ ,  $46_8$ ,  $46_9$  and  $46_{18}$  and common electrode 47, display segments 2, 9, 10, 11, 16, 18, 21, 24, 26, 28, 29, 36 and 37 are activated, and the other segments are not. Accordingly, "paper jamming the supply path" is displayed as shown in Fig. 10. Although Figs. 6 through 9 showed the upper cover 56 of copying machine C closed, in Fig. 10 upper cover 56 of copying machine C is displayed opened, by way of instruction to the operator. Fig. 10 shows that paper jamming occurred when one sheet of copying paper was copied since "1" is displayed on numeral display 38. In this case also, paper jamming can be displayed more conspicuously by flickering segment 24.

In the same manner as mentioned above, each condition is displayed schematically according to the relation between the input and the output

of decoder 42 as shown in Table 1. For example, the display shown in Fig. 11 occurs when a key counter is not inserted into copying machine C. In this case, the indication to insert the key counter (display segment 27) and the standby condition (display segments 36 and 37) are displayed. Further, when toner in the toner hopper runs out, the display appears as shown in Fig. 12. The condition where "no toner" is present is displayed by display segment 33, while the operator is instructed by display segment 34 to open top cover 59 for the toner hopper. When the recovered-toner storage bin is filled with recovered toner, the display appears as shown in Fig. 13. Display segments 9, 10, 11, 12, 13 and 29 are activated, instructing the operator to open upper cover 56 of copying machine C. The recovered-toner storage bin itself is displayed schematically by display segment 32. In the manual paper feed mode, the display appears as shown in Fig. 14 and the "manual paper feed" condition is displayed by display segment 19. When a periodical inspection is required to be performed, the display appears as shown in Fig. 15 and the condition of the "periodical inspection" is displayed schematically by display segment 35. When paper separation from the photosensitive drum occurs, the display appears as shown in Fig. 16, the separation error is displayed by display segments 30 and 31, and the standby condition is displayed schematically by display segments 36 and 37. When paper jamming occurs in the fuser or paper exit path, the display appears as shown in Fig. 17, and the paper jamming condition is displayed schematically by display segments 22, 23 and 25. In Figs. 16 and 17, display segments 9, 10, 11, 12, 13, 28 and 29 are activated to instruct the operator to open upper cover 56 of copying machine C. Further, it is acceptable to flicker display segments 27, 33, 32, 19, 35, 31 and 25 for indicating these conditions.

By means of this display device, each condition of the copying machine can be displayed accurately; and when trouble such as paper jamming occurs, the method of removing jammed paper can be indicated to the operator by displaying the figure of the upper cover in an opened condition, if it is necessary to open it. In this way, the operator becomes more familiar with the machine, the displays are more correct and clear, and more kinds of conditions, with appropriate instructions

to the operator, can be displayed.

In the embodiment mentioned above, explanation is given regarding the case where a liquid crystal display element is used in the display segments. However, even when other luminous elements, such as light emitting diodes, are used, the same effect can be obtained by combining them with a driving means.

Although illustrative embodiments of the invention have been described in detail with reference to the accompanying drawings, it is to be understood that the invention is not limited to those precise embodiments and that various changes and modifications may be effected therein by one skilled in the art without departing from the scope and spirit of the invention.

## Claims:

1. For use with a machine having a plurality of component parts, at least one of which is movable to permit access to be made to other component parts of the machine, a display device comprising a plurality of display segments formed to schematically illustrate at least some of said component parts, including said movable part, and display control means coupled to said display segments for activating selected ones of said display segments in response to the occurrence of a malfunction characterised in that said display control means activates said display segment(s) corresponding to the or each movable part which must be moved to enable the malfunction to be corrected.
2. A display device as claimed in claim 1, characterised in that said display segments schematically illustrate said movable part in its moved position.
3. A display device as claimed in claim 1 or 2, wherein the machine is an electrophotographic copying machine and characterised in that said movable part which must be moved is an upper cover which, when moved, separates said machine into two parts along a paper transportation path.

4. A display device as claimed in claim 3,  
characterised in that, when said display device  
schematically illustrates the upper cover in its opened  
position, it also schematically illustrates the  
5 photosensitive member of the copying machine in a  
raised position.

5. A display device as claimed in claim 3,  
characterised in that said movable part is a cover  
10 which must be opened to permit toner to be added to  
said machine.

6. A display device as claimed in claim 3, 4 or  
5, characterised in that said display segments which  
15 schematically illustrate the main body of the  
electrophotographic copying machine are not activated  
while the machine is in operation.

7. A display device as claimed in claim 1,  
20 characterised in that said display segments are liquid  
crystal display elements.

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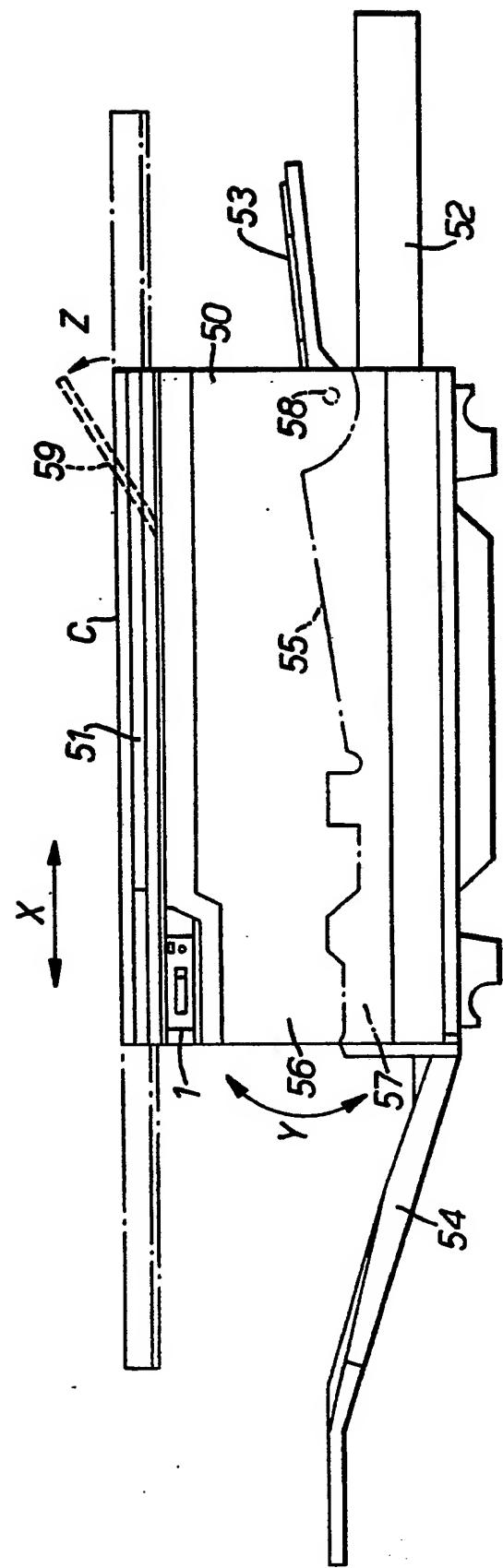
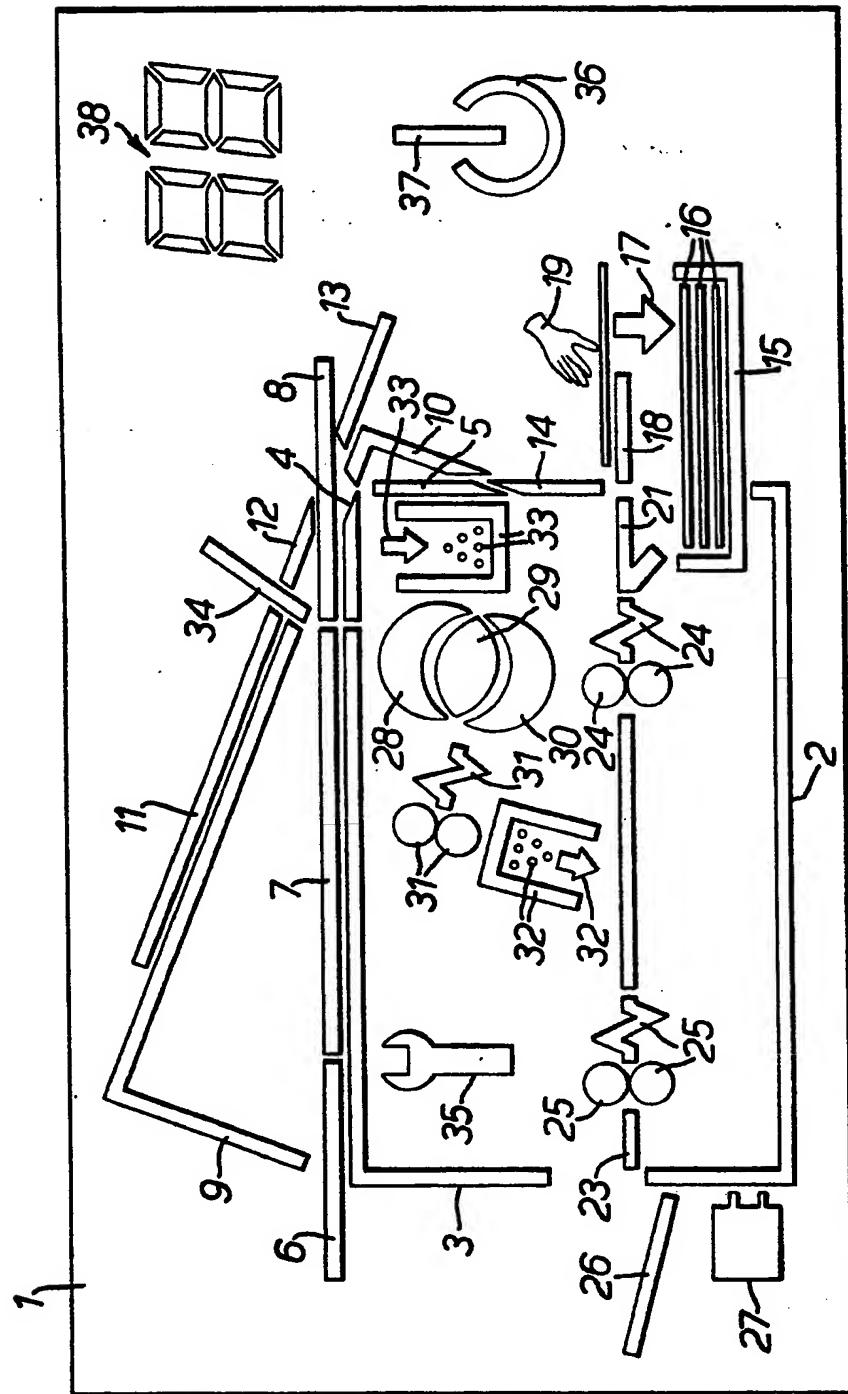


FIG. I.

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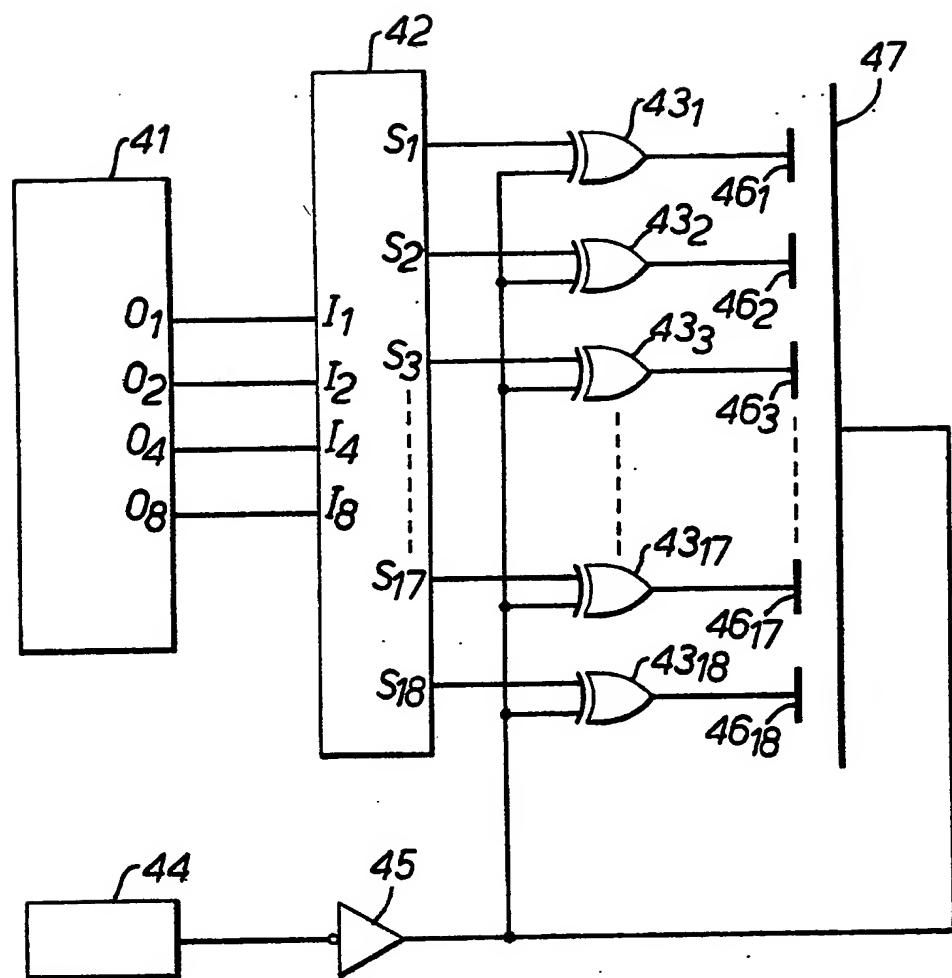


FIG. 3.

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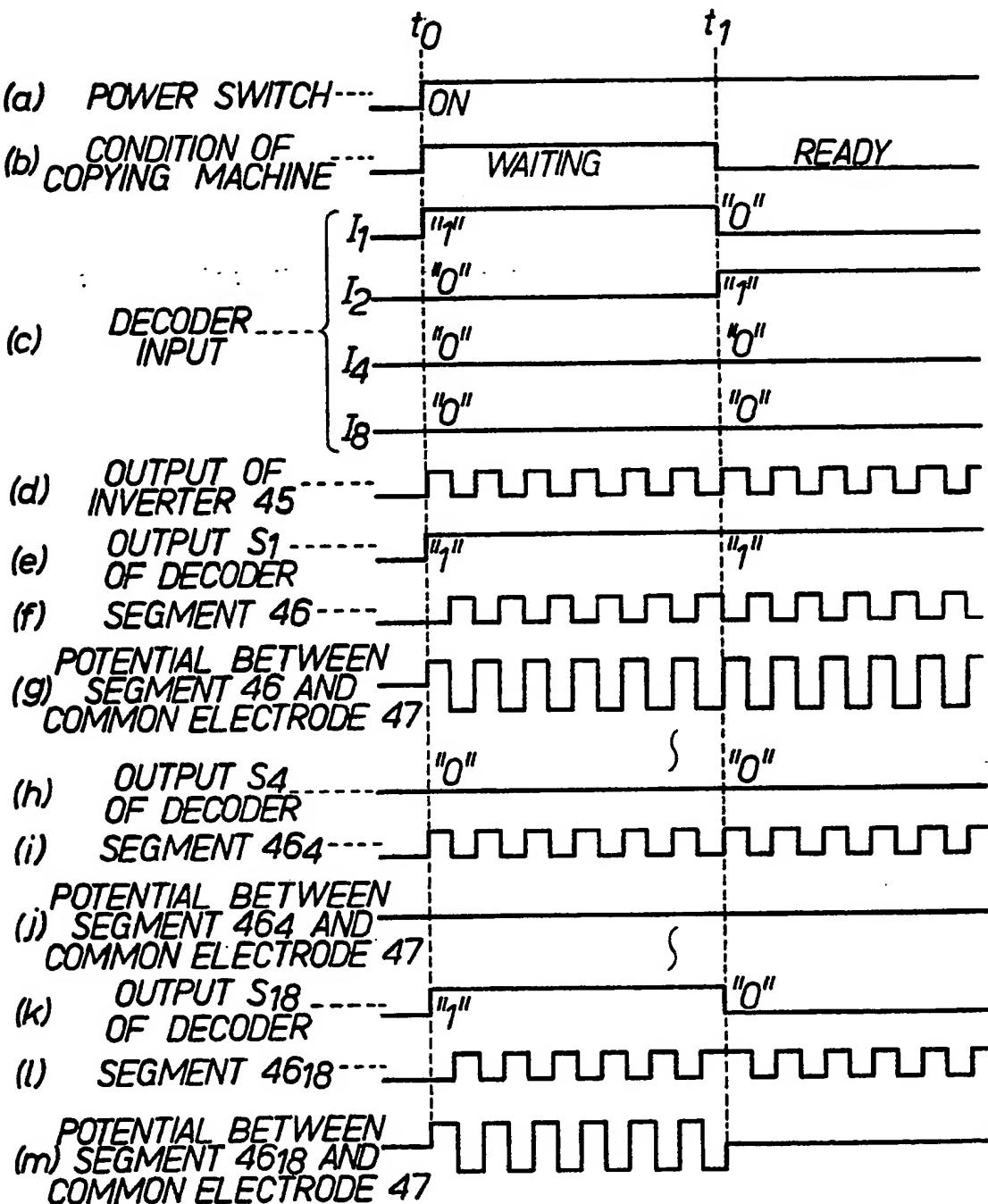


FIG. 4.

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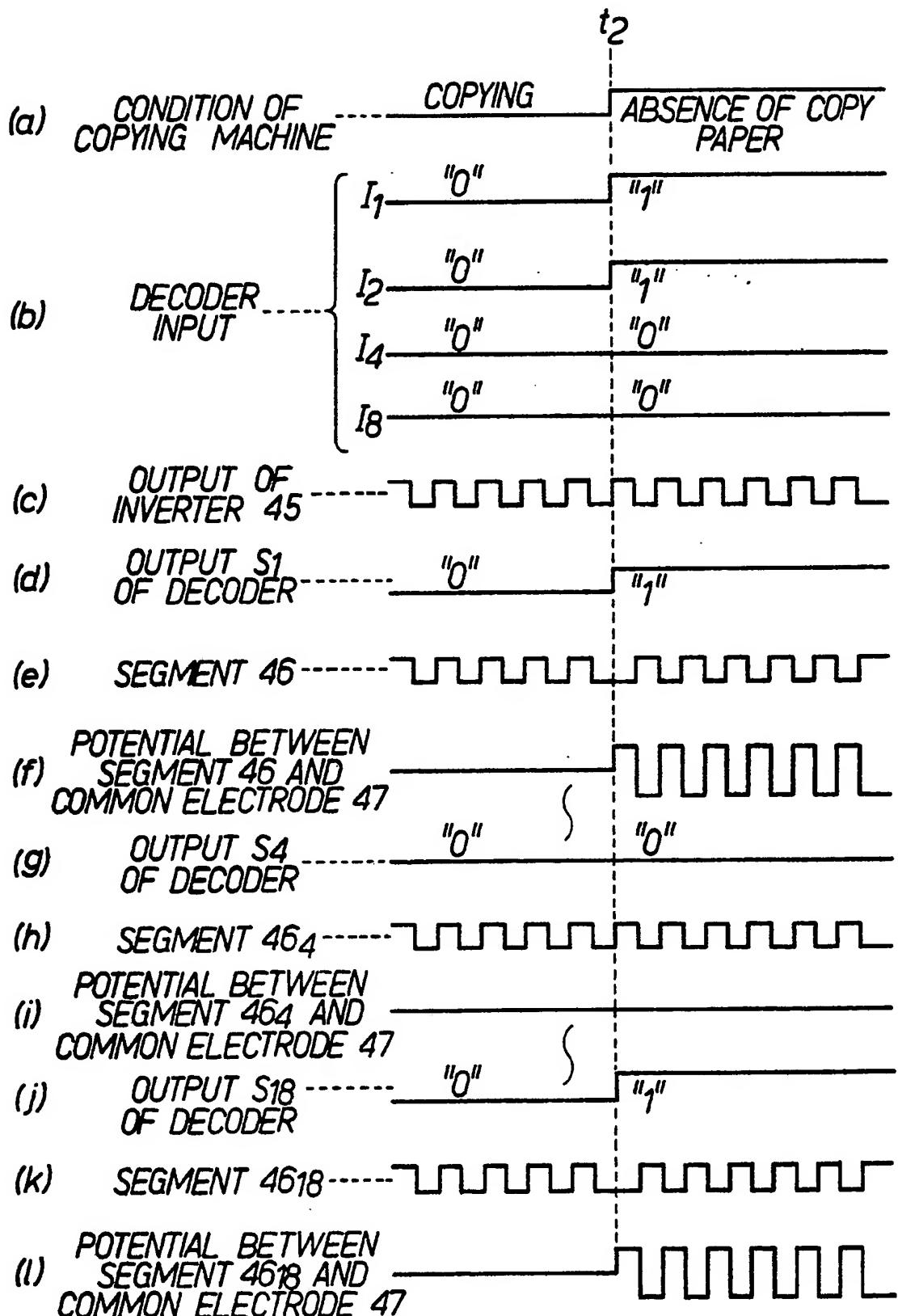


FIG. 5.

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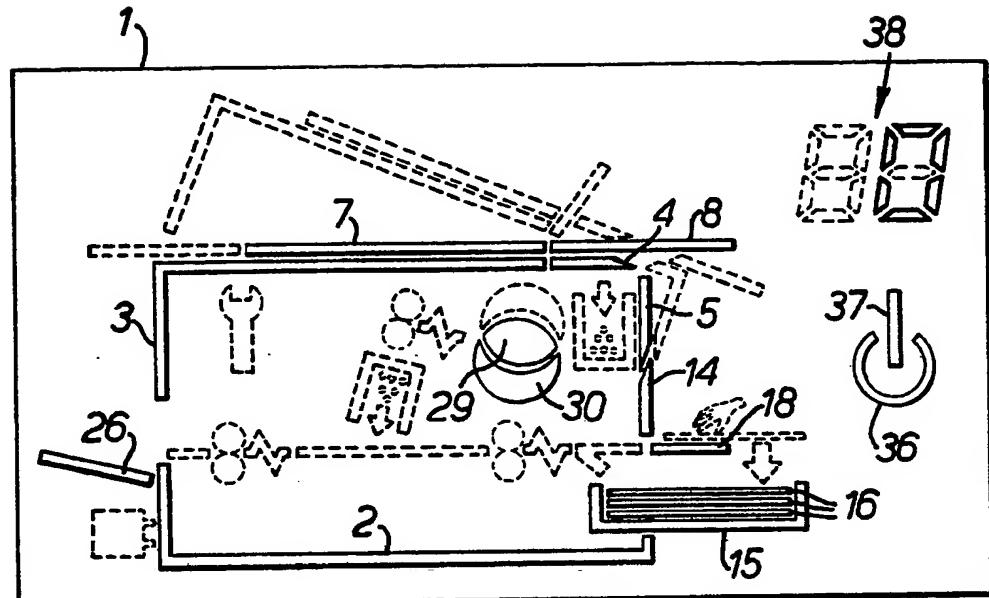


FIG. 6.

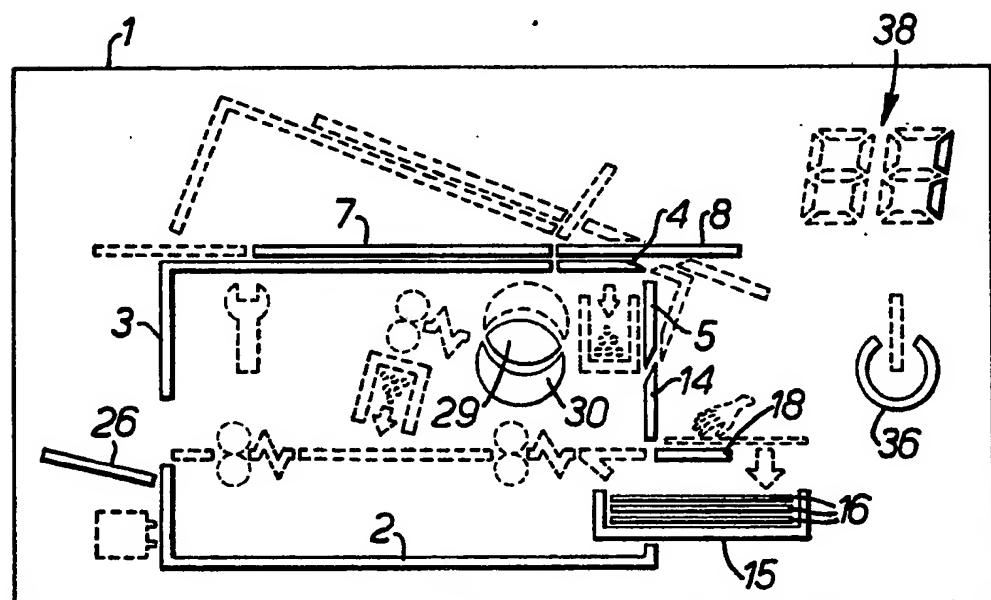


FIG. 7.

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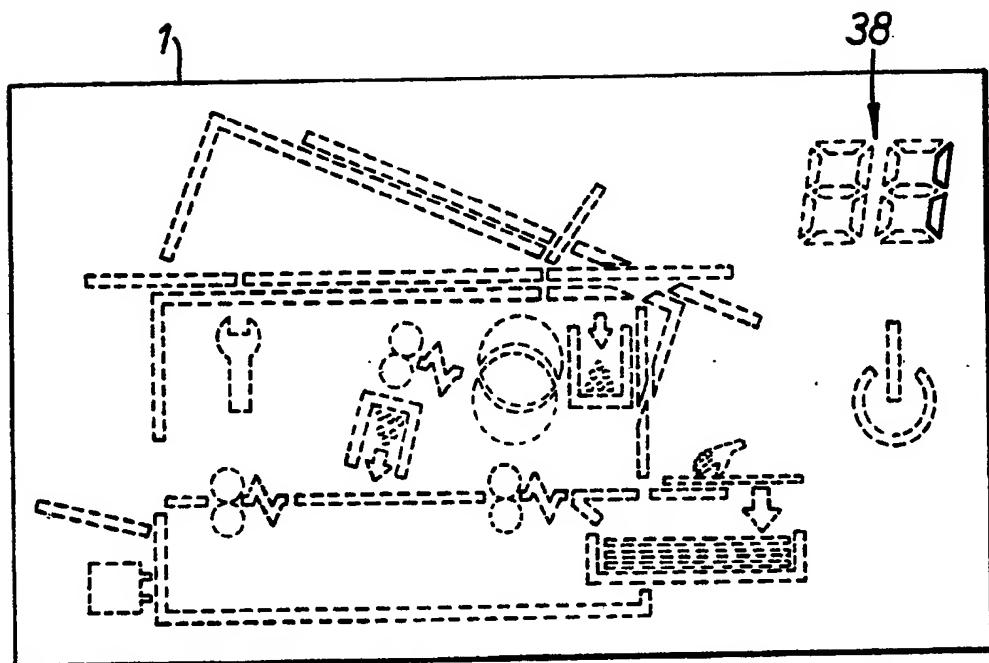


FIG. 8.

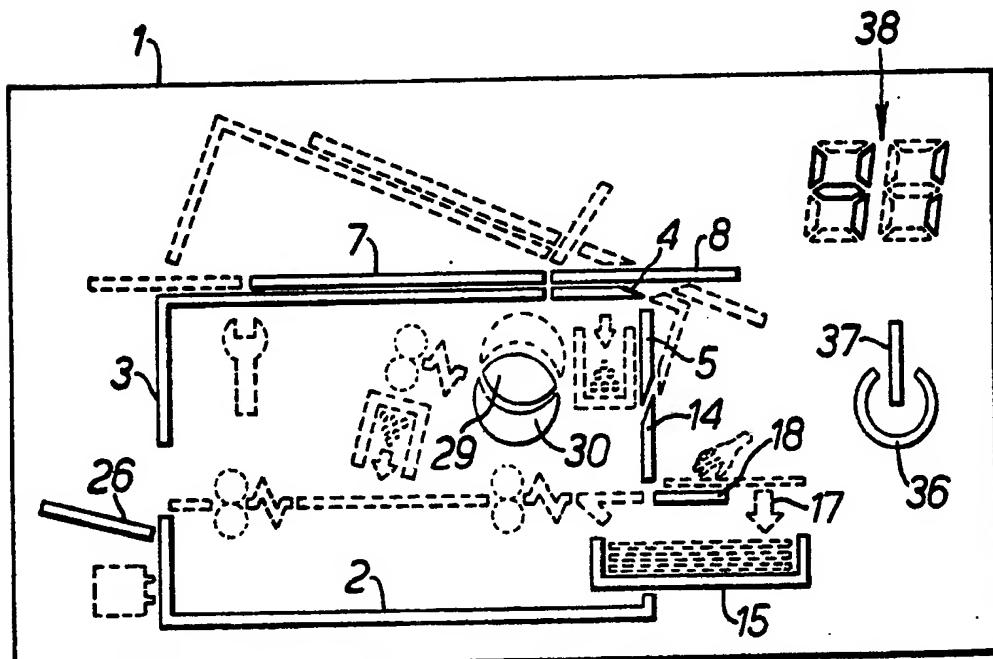


FIG. 9.

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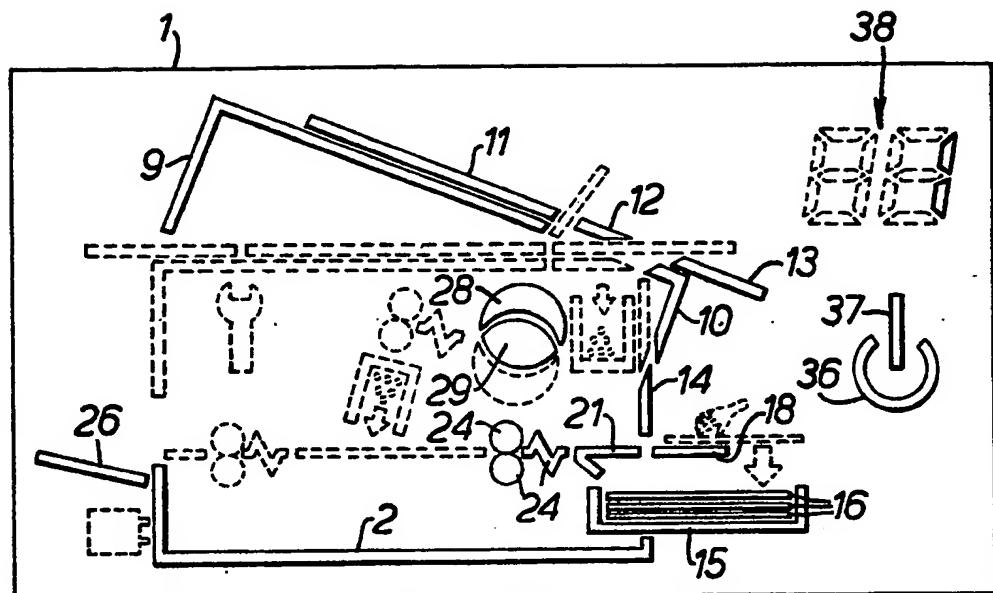


FIG. 10.

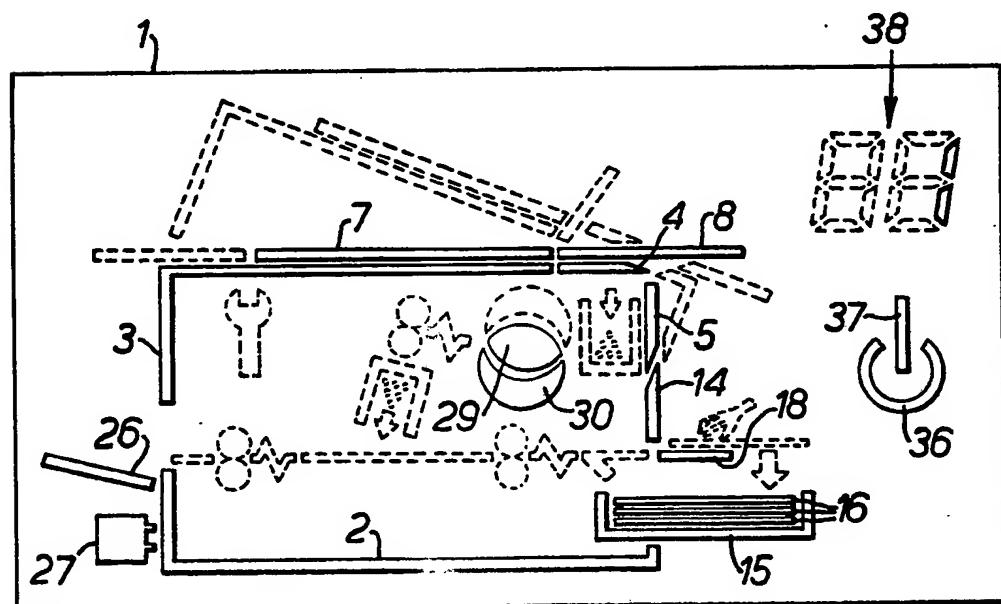


FIG. 11.

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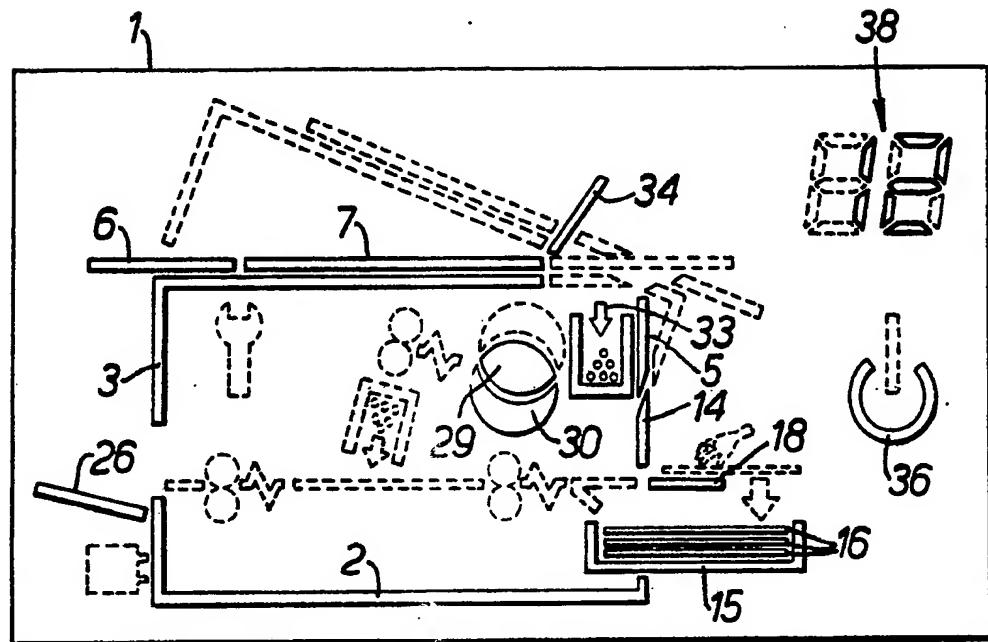


Fig. 12.

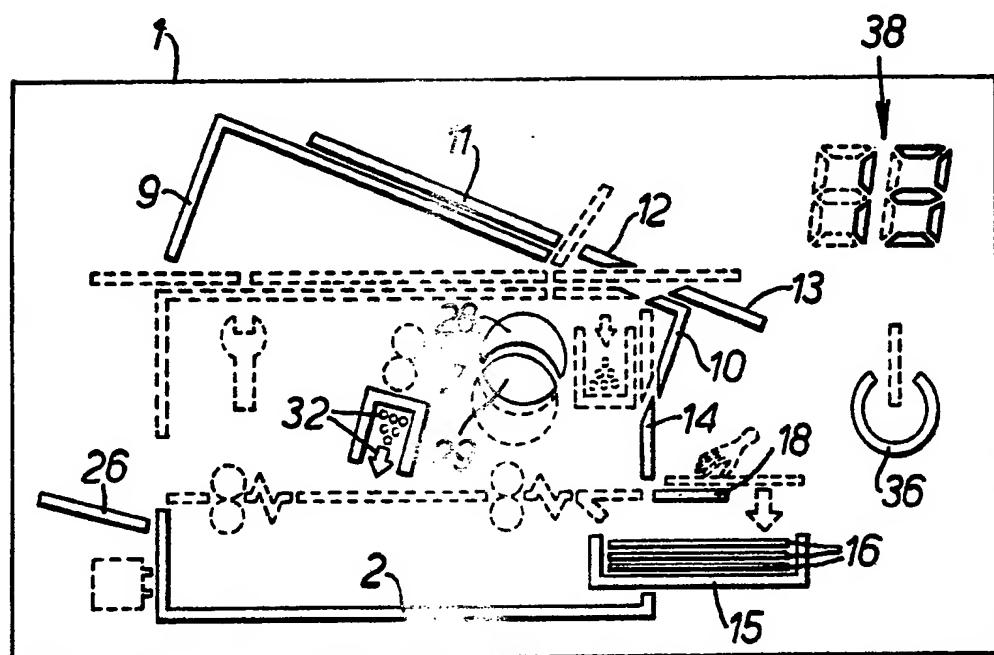
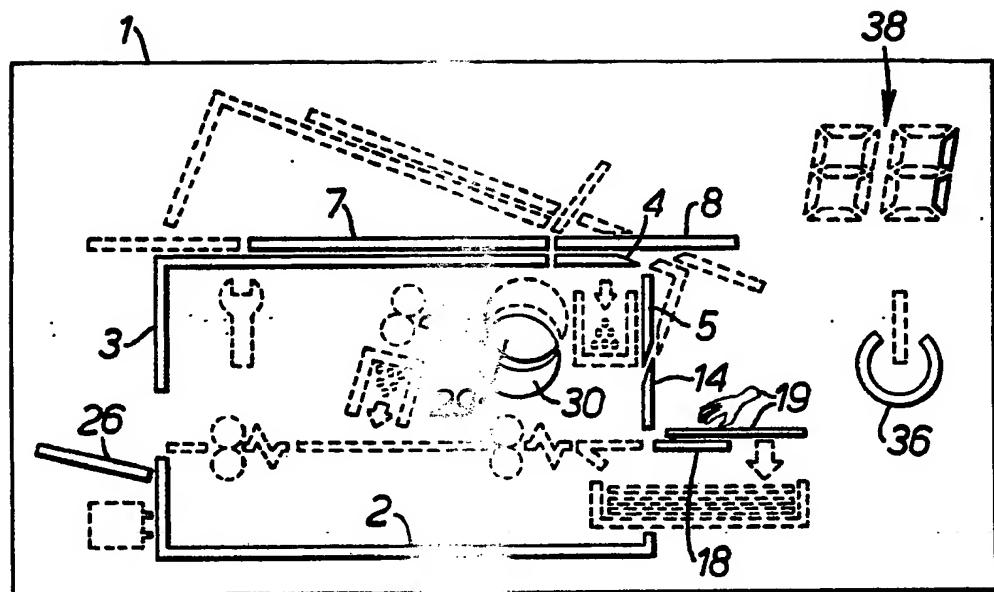


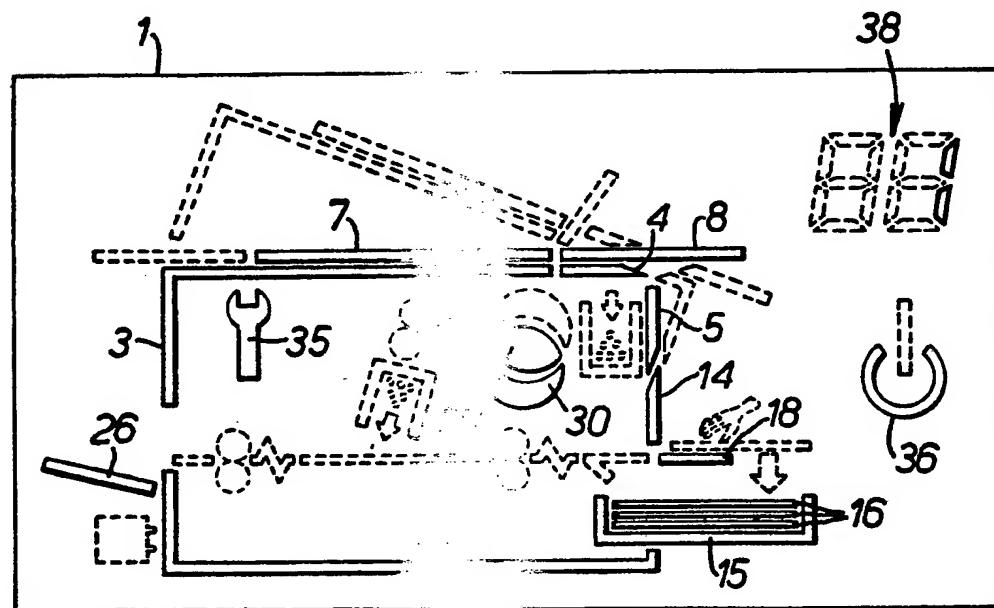
Fig. 13.

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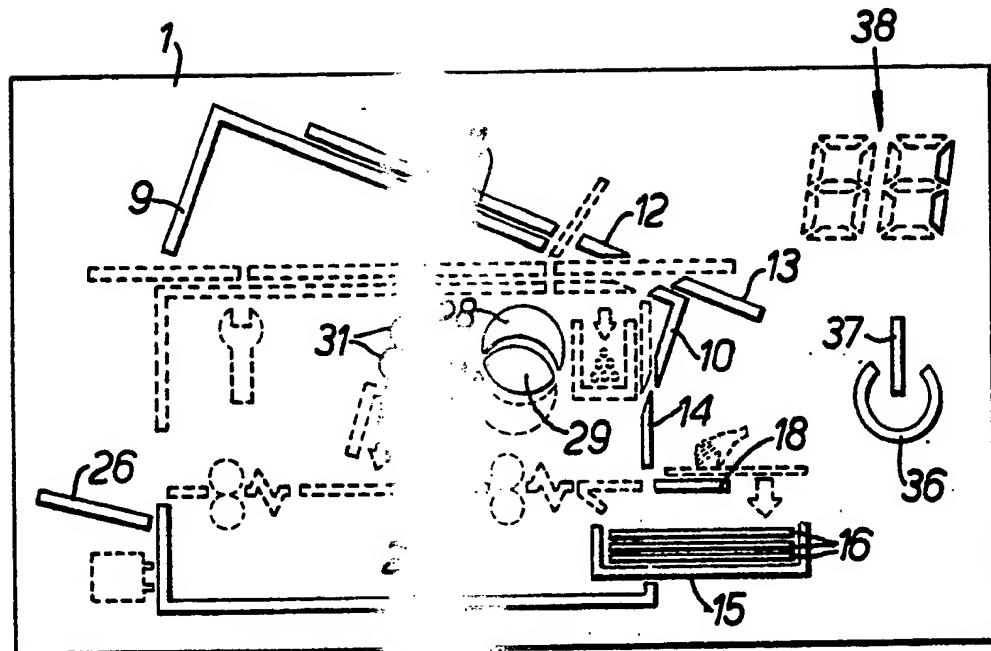


10/11 4.

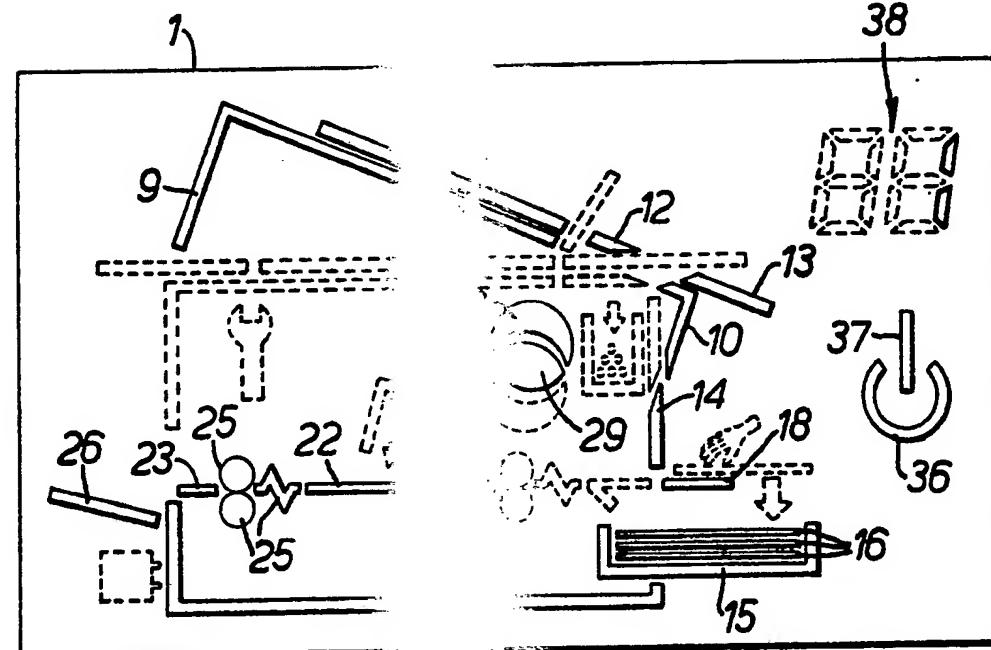


10/11 15.

11.



5.



17.